

NOTE: Refer to the Supplement at the back of this manual for information unique to 2006-on models.

CHAPTER FOUR

4

ENGINE TOP END

The TRX250EX uses an overhead valve pushrod engine. The camshaft is mounted in the crankcase and is driven off the crankshaft by a short cam chain. The camshaft operates followers which move the pushrods against the rocker arms.

This chapter provides complete service and overhaul procedures for the engine top end components. These include the rocker arms, cylinder head, valves, cylinder, piston, piston rings and camshaft. All cylinder head components can be serviced while the engine is in the frame.

When inspecting top end components, compare any measurements to the top end specifications in **Table 2**. Replace any component that is damaged, worn to the service limit or out of specification. During assembly, tighten fasteners to the torque specifications listed in **Table 3**. **Tables 1-3** are at the end of this chapter.

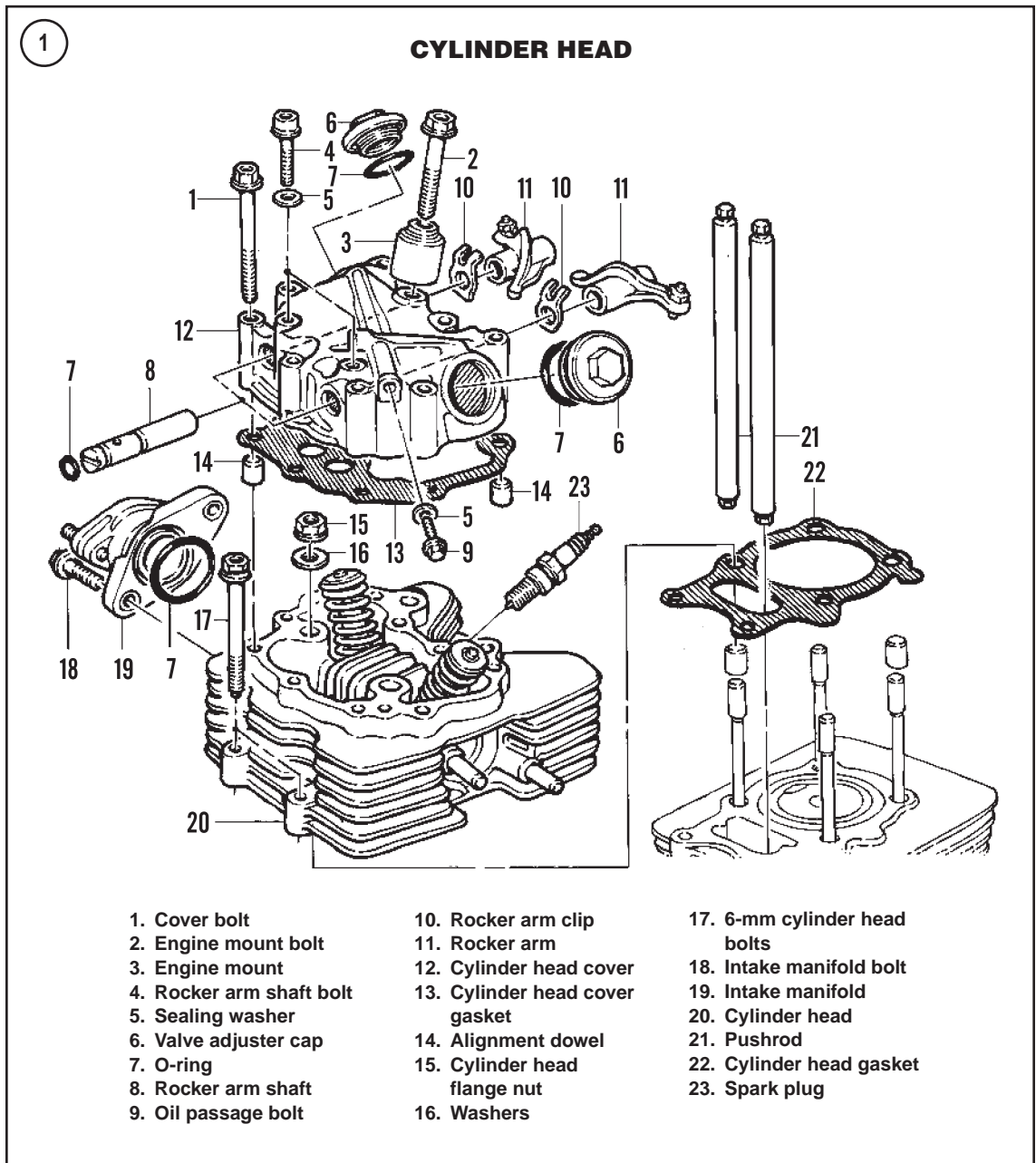
Before starting any work, read the service hints in Chapter One. Make sure the engine and surrounding area is clean before working on the engine top end.

CYLINDER HEAD COVER

Removal/Installation

The cylinder head cover (**Figure 1**) can be removed with the engine in the frame. The cylinder head cover contains the rocker arm assembly. If the cylinder head cover is removed, the valves must be adjusted when the cover is reinstalled.

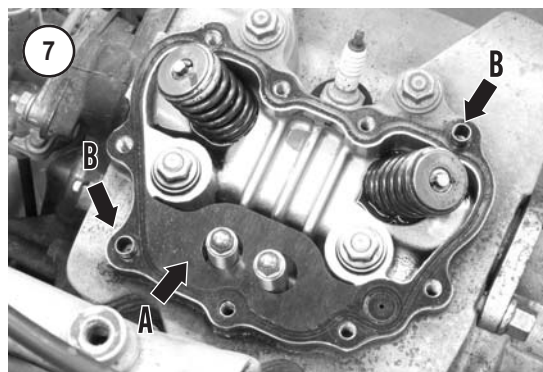
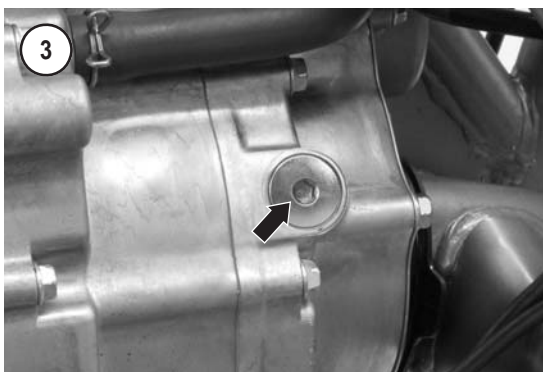
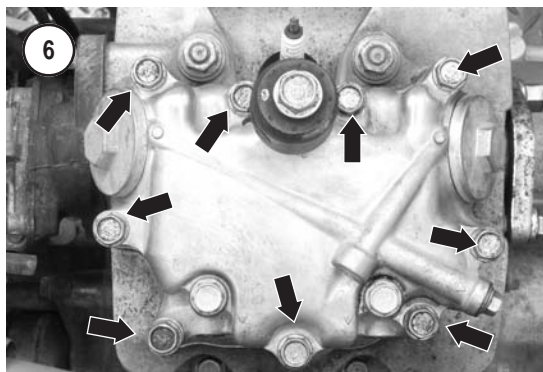
1. Remove the seat, fuel tank cover, side covers and front fender as described in Chapter Fourteen.
2. Disconnect the negative battery cable (**Figure 2**) from the battery.
3. Remove the fuel tank and heat guard as described in Chapter Eight.
4. Remove the two bolts securing the upper motor mount and remove the motor mount.
5. Remove the timing hole cap (**Figure 3**) and O-ring.
6. Set the engine at top dead center on the compression stroke by performing the following:
 - a. Remove the valve adjuster caps (**Figure 4**) from the cylinder head cover.



- b. Remove the cover at the back of the engine covering the alternator bolt. Using a wrench, slowly turn the bolt counterclockwise until the T-mark (**Figure 5**) on the flywheel aligns with the index mark on the alternator cover.
- c. Check that the piston is at TDC on its compression stroke by moving both rocker arms by hand. Each rocker arm should have some free play. If both rocker arms are tight, turn the

crankshaft one full turn counterclockwise and realign the flywheel T-mark with the index mark. Check that both rocker arms are loose.

7. If the rocker arm assemblies will be removed from the cylinder head cover, loosen the two rocker arm shaft bolts at this time.
8. Following a crossing pattern, loosen and remove the cylinder head cover bolts (**Figure 6**). Lift the cover from the cylinder head.



9. Remove the cylinder head cover gasket (A, **Figure 7**) and the alignment dowels (B).

10. Clean and dry the cylinder head cover. Remove the oil passage access bolt (**Figure 8**) and flush the cylinder head cover oil passages with compressed air.

11. Reverse the removal procedure to install the cylinder head cover. Note the following:

- Install a new cylinder head cover gasket (A, **Figure 7**).
- If the engine was turned over after the cylinder head cover was removed, reposition the engine at TDC by turning the alternator bolt

counterclockwise until the flywheel T-mark (**Figure 5**) aligns with the index mark on the alternator cover.

- c. Lubricate the rocker arm contact surfaces (**Figure 9**) with engine oil.
- d. Loosen the two valve adjuster locknuts and rocker arm adjusters, and then install the cylinder head cover.

CAUTION

The engine must remain at TDC while the cylinder head cover bolts are installed and tightened.

- e. Following a crossing pattern, tighten the cylinder head cover bolts evenly in several passes to 12 N•m (106 in.-lb.).
- f. If the rocker arm shaft bolts require final tightening, tighten the bolts to 10 N•m (89 in.-lbs.).
- g. Adjust the valve clearance as described in Chapter Three.

ROCKER ARMS

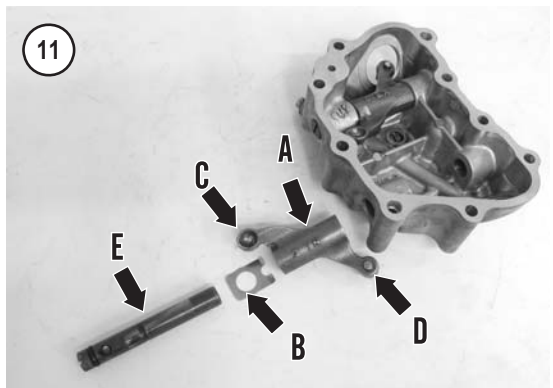
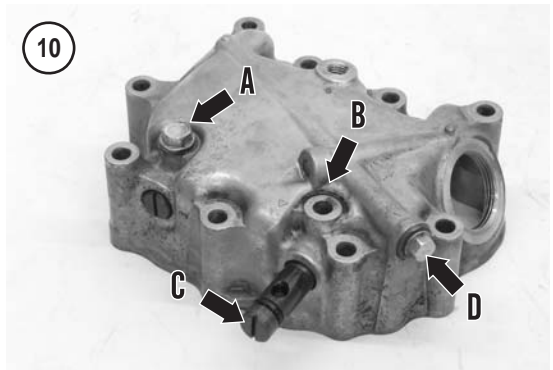
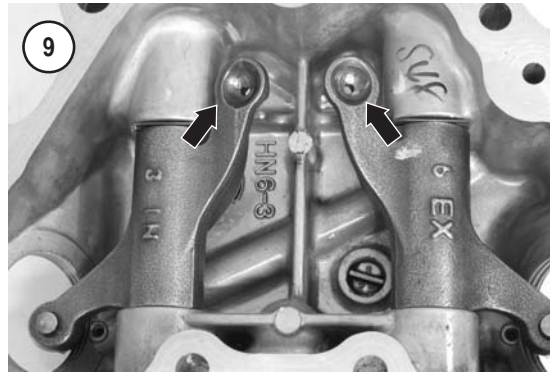
Disassembly/Inspection/Assembly

Refer to **Table 2** when inspecting the rocker arm components. Inspect each set of parts, keeping each rocker arm with its original shaft. Replace worn or damaged parts.

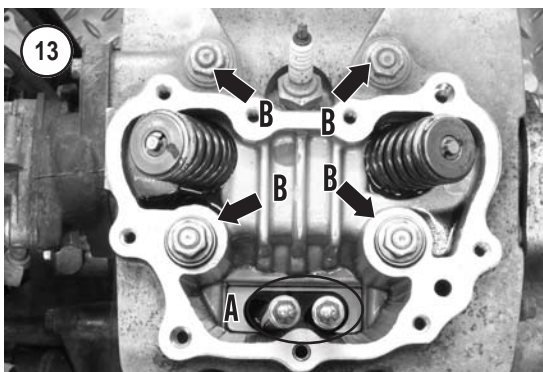
CAUTION

Before removal, mark each rocker arm so it can be identified. The rocker arms must be reinstalled in their original locations.

1. Remove the cylinder head cover as described in this chapter.
2. Remove the rocker arm shaft bolts (A, **Figure 10**) from the cover.
3. Remove each rocker arm assembly as follows:
 - a. Insert a small screwdriver into the bolt hole (B, **Figure 10**), and then push the rocker arm shaft (C) from the cover.
 - b. Remove the rocker arm (A, **Figure 11**) and spring clip (B, **Figure 11**).
4. Clean and dry the cylinder head cover. Remove the oil passage bolt (D, **Figure 10**) and flush the oil passages with compressed air.



5. Inspect each rocker arm for wear and damage as follows:
 - a. Inspect the rocker arm pushrod socket (C, **Figure 11**) contact point.
 - b. Inspect the valve adjuster (D, **Figure 11**) contact point, threads and locknut.
6. Inspect the rocker arm shaft (E, **Figure 11**) for wear, scoring, or other damage. Replace if necessary.
7. Measure the rocker arm bore inside diameter with a small bore gauge and micrometer. If the bore



is within specification, record the dimension and continue the procedure.

8. Measure the rocker arm shaft outside diameter where both rocker arms pivot. If the shaft is within specification, record the dimension and continue the procedure.

9. Calculate the rocker arm-to-rocker arm shaft clearance by subtracting the rocker arm shaft outside diameter from the rocker arm bore inside diameter. Replace the rocker arms and/or the shafts if the clearance is out of specification.

10. Lubricate the rocker arm bore and shaft with engine oil. Install a new O-ring on the shaft.

11. Install each rocker arm assembly into the cylinder head cover as follows:

- Install the rocker arm shaft into the cylinder head cover. The slotted end of the shaft (C, **Figure 10**) must face out.
- Working inside the cylinder cover, slide the spring clip (B, **Figure 11**) onto the shaft. The prongs on the clip must face toward the top of the cover and point toward the rocker arm location.

- Install the rocker arm (A, **Figure 11**), checking that it is properly oriented.
- Install a new sealing washer on the rocker arm shaft bolt (A, **Figure 10**).
- Use a screwdriver and turn the rocker arm shaft to align the hole in the shaft with the bolt hole in the cover (B, **Figure 10**).
- Install the rocker arm shaft bolt and tighten it to 10 N•m (89 in.-lbs.). If desired, to keep the cover stable, the bolt can be tightened after the cylinder head cover has been installed on the engine.
- Check that the rocker arm pivots smoothly on the rocker arm shaft.

12. Install the cylinder head cover as described in this chapter.

CYLINDER HEAD AND PUSHRODS

The cylinder head and pushrods can be removed with the engine mounted in the frame. Some photographs show the engine removed from the frame for clarity. Refer to **Figure 1**.

Cylinder Head Removal/Installation

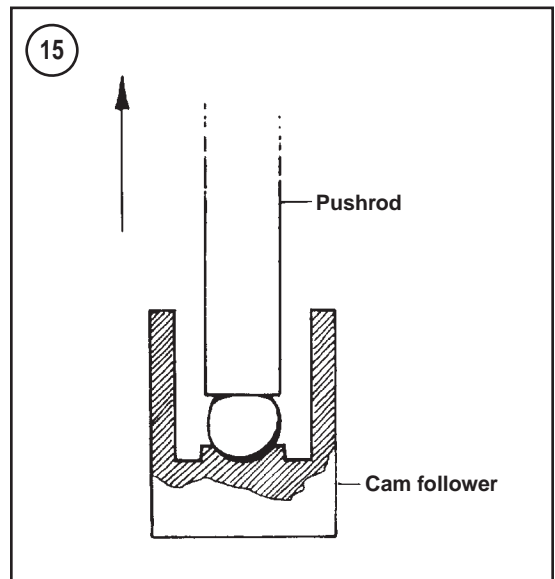
- Perform Steps 1-7 of *Cylinder Head Cover Removal/Installation* (this chapter).
- Remove the exhaust pipe and carburetor as described in Chapter Eight.
- Remove the intake manifold and O-ring.
- Perform Steps 8-10 of *Cylinder Head Cover Removal/Installation* (this chapter).

NOTE

*In the following step, identify and mark the intake and exhaust pushrods. Mark the end of the pushrod that points up (**Figure 12**). The push rods must be installed in their original locations and operating positions. Also, note the pushrod passage in the cylinder head for each pushrod.*

- Remove the two pushrods (A, **Figure 13**).
- Remove the 6-mm cylinder head mounting bolts (**Figure 14**), located on the right side of the head.
- Following a crossing pattern, loosen the cylinder head flange nuts (B, **Figure 13**) evenly in two or three steps. Remove the nuts and washers.

8. Carefully raise the cylinder head. If the head is stuck to the cylinder, tap the cylinder head with a plastic mallet to break it loose.
9. Remove the cylinder head gasket.
10. Cover the cylinder with a clean shop cloth to prevent debris from entering the engine.
11. Inspect the cylinder head and pushrods as described in this section.
12. Reverse this procedure to install the cylinder head. Note the following:
 - a. Clean all gasket residue from the cylinder head and cylinder mating surfaces.
 - b. Install a new cylinder head gasket. Properly orient the gasket so the dowels fit correctly.
 - c. Lubricate the pushrod ends with engine oil.
 - d. Install the pushrods (**Figure 12**), noting their correct position and direction of installation. Check that each pushrod is seated in the center of its cam follower groove as shown in **Figure 15**.
 - e. Apply engine oil to the four cylinder head flange nuts (**B, Figure 13**) and install the nuts.
 - f. Following a crossing pattern, tighten the cylinder head flange nuts in 2-3 steps to 30 N•m (22 ft.-lb.).
 - g. Install the two 6-mm cylinder head mounting bolts (**Figure 14**) and tighten securely.
 - h. If necessary, replace the O-ring on the intake manifold to assure proper sealing.
 - i. When installing the manifold, check that the “HN6” mark is facing up.

**CAUTION**

When using a tap to clean spark plug threads, coat the tap with tap-cutting fluid or kerosene.

CAUTION

Aluminum spark plug threads can be damaged by galling, crossthreading and overtightening. To prevent galling, apply an antiseize compound to the plug threads before installation. Do not overtighten the spark plug.

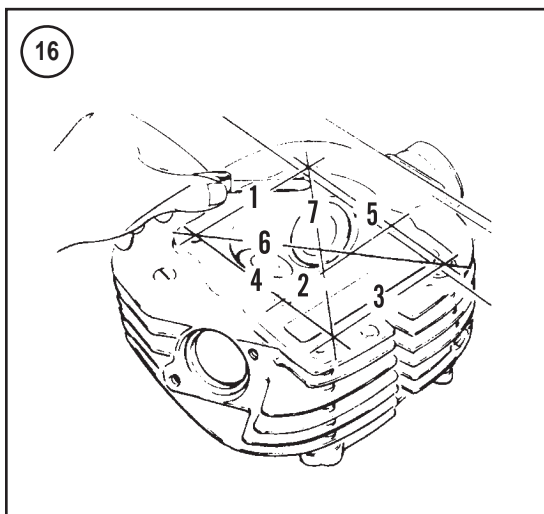
Cylinder Head Inspection

1. Remove all gasket residue from the cylinder head gasket surfaces. Do not scratch the gasket surface.
2. Without removing the valves, remove all carbon deposits from the combustion chamber. Use a fine-wire brass brush dipped in solvent or use a wood or plastic scraper. Prevent damaging the head, valves or spark plug threads.

CAUTION

Do not clean the combustion chamber after removing the valves. Damage to the valve seat surfaces is possible, resulting in poor valve seating.

3. Examine the spark plug threads in the cylinder head for damage. If damage is minor or if the threads are dirty or clogged with carbon, use a spark plug thread tap to clean the threads. If thread damage is excessive, restore the threads with a steel thread insert.

**NOTE**

If the cylinder head was bead blasted, clean the head first with solvent, and then with hot soapy water. Residual grit that settles in small crevices and other areas can be hard to dislodge. Also, chase each exposed thread with a tap to remove grit trapped between the threads. Residual grit left in the engine will cause premature piston, ring and bearing wear.

4. After cleaning the combustion chamber, valve ports and spark plug thread hole, clean the entire head in solvent.

5. Examine the piston crown. The crown must show no signs of wear or damage. If the crown appears pitted or spongy, also check the spark plug, valves and combustion chamber for aluminum deposits. If these deposits are found, the cylinder is overheating due to a lean fuel mixture or preignition.

6. Check the combustion chamber and exhaust port for cracks.

7. Place a straightedge across the gasket surface and measure cylinder head warp (**Table 2**) by inserting a feeler gauge between the straightedge and cylinder head at the locations shown in **Figure 16**. Warp or nicks in the cylinder head surface could cause an air leak and overheating. If the head is warped, resurface or replace the cylinder head. Consult with a Honda dealership or a machine shop for this type of work.

8. Inspect the intake manifold for cracks or other damage that would allow air to bypass the carburetor and cause poor fuel delivery or a lean operating condition.

9. Inspect the exhaust pipe studs for damage. If necessary, replace the studs as described in Chapter One.

10. Check the cylinder head flange nuts and washers for damage. If damage is evident, replace all the nuts and washers as a set.

11. If necessary, service the valves as described in *Valves and Valve Components* (this chapter).

Pushrod Inspection**NOTE**

Although both pushrods are identical (same part number), used pushrods must be reinstalled in their original mounting positions. When cleaning and inspecting the pushrods, do not remove the identification marks made during removal.

Replace the pushrods (**Figure 12**) if they show excessive wear or damage.

1. Clean and dry the pushrods.
2. Roll each pushrod on a flat surface and check for bending.
3. Check the pushrod ends for uneven wear, cracks or signs of heat damage (discoloration).

VALVES AND VALVE COMPONENTS

A complete valve job, which consists of reconditioning the valve seats and replacing the valve guides, requires special tools. This section describes service procedures for checking the valve components and for determining the type of service required. Along with the special tools, considerable expertise is required to properly recondition the valves seats. Because of the cost of the equipment and their infrequent need by the typical do-it-yourselfer, valve service is generally entrusted to machine shops specializing in this type of work.

If the tools are available, follow the tool manufacturer's instruction and refer to the following procedures.

Although some of the photos in this section show the valve configuration used on an earlier version of

this engine, all procedures and techniques are applicable to the current design.

Tools

A valve spring compressor is required to remove and install the valves. This tool compresses the valve springs so the valve keepers can be released from the valve stem. Do not remove or install the valves without a valve spring compressor. Because of the limited working area, most automotive type valve spring compressors do not work. Rent or purchase a valve spring compressor designed for ATV and motorcycle applications.

Solvent Test

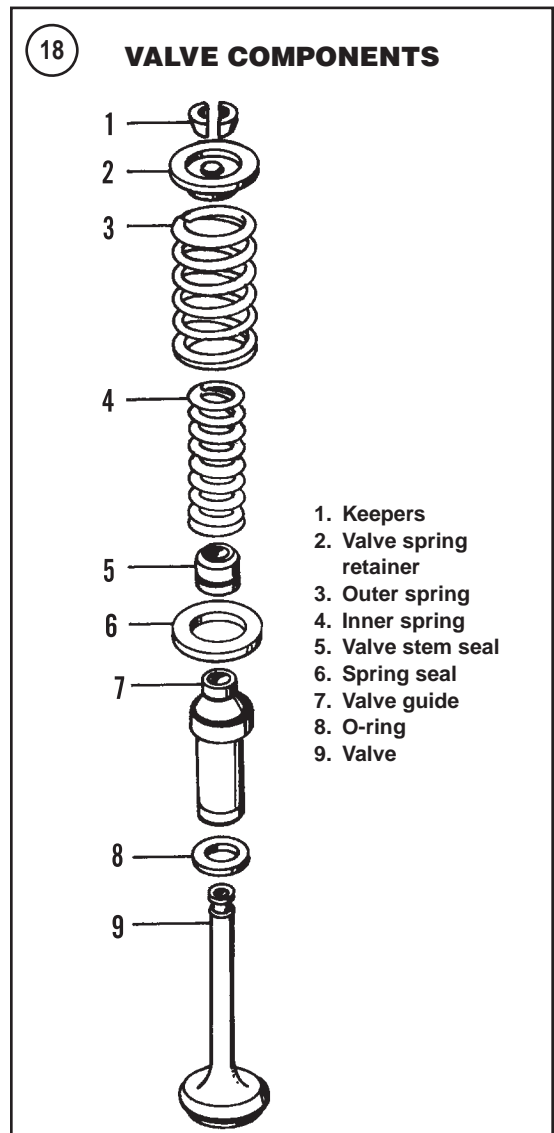
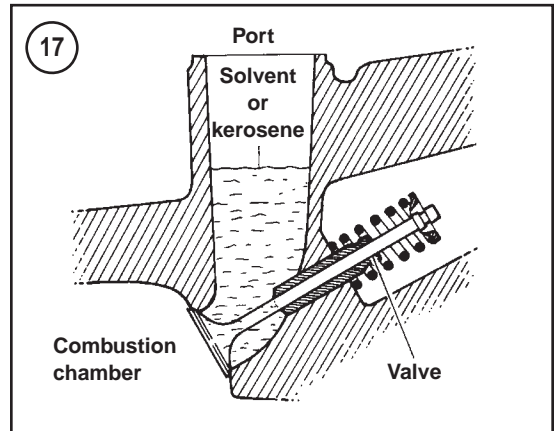
For proper engine operation, the valves must seat tightly against their seats. Any condition that prevents the valves from seating properly can cause valve burning and reduced engine performance. Before removing the valves from the cylinder head, perform the following:

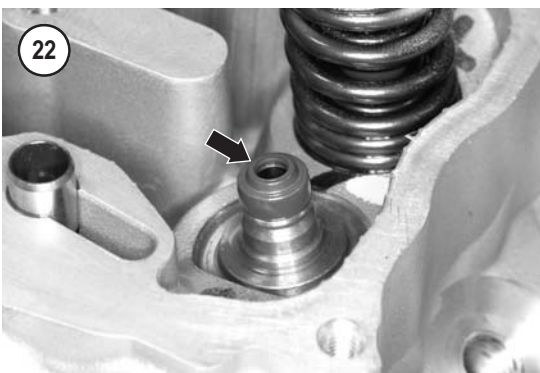
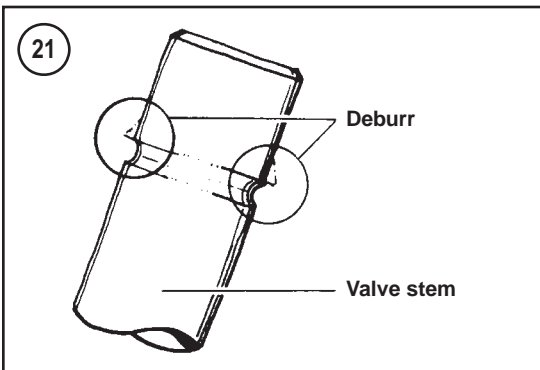
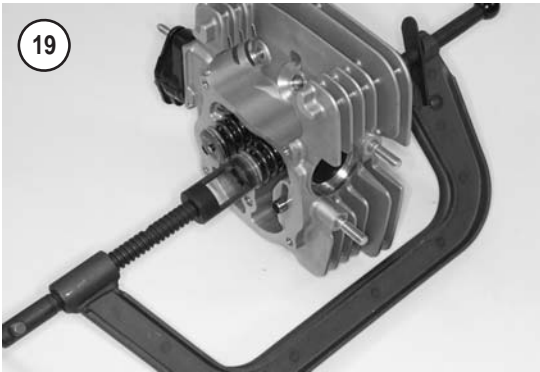
1. Remove the cylinder head as described in this chapter.
2. Support the cylinder so the exhaust port faces up (**Figure 17**) and pour solvent or kerosene into the port. Check the combustion chamber for fluid leaking past the exhaust valve seat.
3. Repeat Step 2 for the intake port and intake valve and seat.
4. If fluid leaks around a valve seat, the valve is not seating properly. The following conditions can cause poor valve seating:
 - a. A bent valve stem.
 - b. A worn or damaged valve seat (in the cylinder head).
 - c. A worn or damaged valve face.
 - d. A crack in the combustion chamber.

Valve Removal

Refer to **Figure 18**.

1. Remove the cylinder head as described in this chapter.
2. Install a valve spring compressor squarely over the valve spring seat with the other end of the tool placed against valve head (**Figure 19**). Position the head of the valve spring compressor so the valve keepers are accessible.



**WARNING**

Wear safety glasses or goggles when performing Step 3.

CAUTION

When compressing the valve springs, do not compress them any more than necessary.

3. Tighten the valve spring compressor to remove all tension from the upper spring seat and valve keepers. Remove the valve keepers (**Figure 20**) with pliers or a magnet.
4. Slowly loosen the valve spring compressor, and remove it from the head.
5. Remove the valve spring retainer and both valve springs.

CAUTION

*Remove any burrs from the valve stem groove (**Figure 21**) before removing the valve; otherwise, the valve guide can be damaged as the valve stem passes through it.*

6. Remove the valve from the cylinder head.
7. Pull the valve stem seal (**Figure 22**) from the valve guide and discard the seal.
8. Remove the lower spring seat.

CAUTION

Keep all parts of each valve assembly together. Do not mix components from the different valves assemblies. Excessive wear may result.

9. Repeat the procedure to remove the remaining valve.
10. Inspect the valves as described in this section.

Valve Installation

1. Clean and dry all parts. If the valve seats were machined, lapped or if the valve guides were replaced, thoroughly clean the valves and cylinder head in solvent, and then wash the head with hot soapy water. All lapping and grinding compound must be washed away. After drying the cylinder head, lubricate the valve guides with engine oil to prevent rust.
2. Install the spring seat (**Figure 23**).

NOTE

New valve seals must be installed whenever the valves are removed. The valve seals are color coded and not interchangeable. The intake valve seal is green; the exhaust seal is brown.

3. Install new valve seals as follows:
 - a. Lubricate the inside of each new valve seal with molybdenum disulfide paste.
 - b. Install the new valve seal (**Figure 22**) over the valve guide and seat it into place.
4. Coat the valve stem with molybdenum disulfide paste. Install the valve part way into the guide. Slowly turn the valve as it enters the valve seal, and continue turning the valve until it is completely installed.

NOTE

*Install each valve spring so the end with the closer wound coils (**Figure 24**) faces in toward the cylinder head.*

5. Install the inner and outer valve springs (**Figure 25**).
6. Install the valve spring retainer (**Figure 26**).

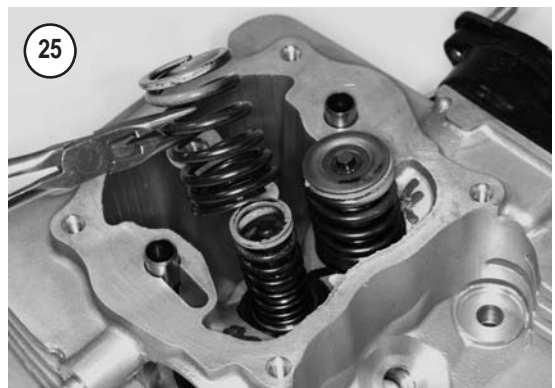
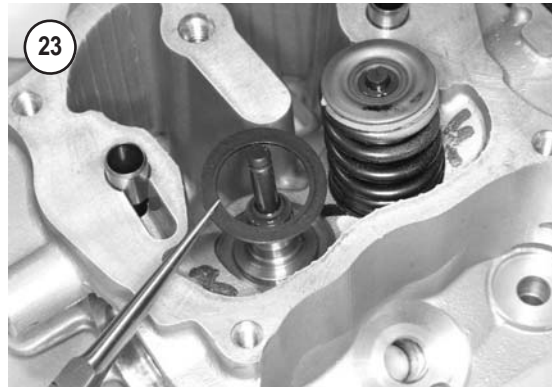
WARNING

Wear safety glasses or goggles when compressing the valve springs.

7. Install the valve spring compressor. Push down on the upper valve seat and compress the springs, and then install the valve keepers (**Figure 20**).
8. Slowly release the tension from the compressor and remove it. After removing the compressor, inspect the valve keepers to make sure they are properly seated (**Figure 27**). Tap the end of the valve stem (**Figure 28**) with a drift and hammer. This ensures the keepers are completely seated.
9. Repeat the installation procedure for the opposite valve.
10. After installing the cylinder head and rocker arm holder onto the engine, adjust the valve clearance as described in Chapter Three.

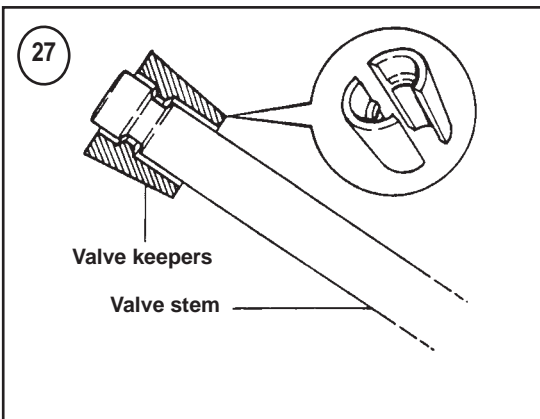
Component Inspection

When inspecting the valve components, compare the actual measurements to the specifications in **Table 2**. Replace parts that are damaged, worn to the service limit or out of specification.



Refer to **Figure 29** when inspecting and troubleshooting the valves.

1. Clean the valves in solvent. Do not gouge or damage the valve seating surface.
2. Inspect the contact surface (**Figure 30**) of each valve for burning. Minor roughness and pitting can be removed by lapping the valve as described in this section. Excessive unevenness in the contact surface is an indication that the valve is not serviceable.



3. Inspect the valve stems for wear and roughness. Measure the valve stem diameter (**Figure 31**) for wear. Record the measurement.

4. Remove all carbon and varnish from the valve guides with a stiff spiral wire brush before measuring wear.

5. Measure each valve guide inside diameter at its top, center and bottom of the valve guide bore with a small hole gauge. Measure the small hole gauge with

a micrometer (**Figure 32**) to determine the valve guide inside diameter. Record the measurement.

6. Subtract the valve stem outside diameter (Step 3) from the valve guide inside diameter (Step 5). The difference is the valve stem-to-guide clearance.

7. If the valve stem-to-guide clearance exceeds the service limit, determine if a new valve guide would bring the valve stem-to-guide clearance within specification. If it will, replace the valve guide. If it will not, replace both the valve guide and the valve. Refer to *Valve Guide Replacement* in this section.

8. Inspect the inner and outer valve springs by performing the following:

- Check each valve spring for visual damage.
- Use a square and check each spring for distortion or tilt (**Figure 33**).
- Measure the valve spring free length with a caliper (**Figure 34**).
- Replace worn or damaged springs as a set.

9. Check the valve spring seats and valve keepers for cracks or other damage.

10. Inspect the valve seats (**Figure 35**) for burning, pitting, cracks, excessive wear or other damage. If worn or burned, they may be reconditioned as described in this section. Seats and valves in near-perfect condition can be reconditioned by lapping with fine carborundum paste. Check the valve seats by performing the following:

- Clean the valve seat and valve mating areas with contact cleaner.
- Spread a thin layer of marking compound evenly on the valve seat.
- Install the valve into its guide and rotate it against its seat with a valve lapping tool. Refer to *Valve Lapping* in this section.
- Lift the valve out of the guide and measure the seat width (**Figure 36**) with a vernier caliper.
- Make sure the seat width is within the specification in **Table 2** all the way around the seat. If the seat width exceeds the service limit, refer to *Valve Seat Reconditioning* in this section.
- Remove all marking compound residue from the seats and valves.

Valve Guide Replacement

A 5.5-mm valve guide reamer (Honda part No. 07984-2000001 or 07984-2000001D) and 5.5-valve guide driver (Honda part No. 07742-0010100), or

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VALVE TROUBLESHOOTING

Valve deposits

Check:

- Worn valve guide
- Engine ignition and/or carburetor adjustments incorrect
- Dirty or gummed fuel
- Dirty engine oil

Valve sticking

Check:

- Worn valve guide
- Bent valve stem
- Deposits collected on valve stem
- Valve burning or overheating

Valve burning

Check:

- Valve sticking
- Cylinder head warped
- Valve seat distorted
- Valve clearance distorted
- Valve clearance incorrect
- Incorrect valve spring
- Valve spring worn
- Valve seat worn
- Carbon buildup in engine
- Engine ignition and/or carburetor adjustments incorrect

Valve seat/face wear

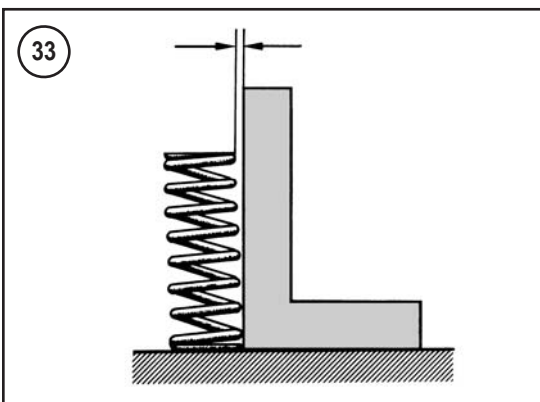
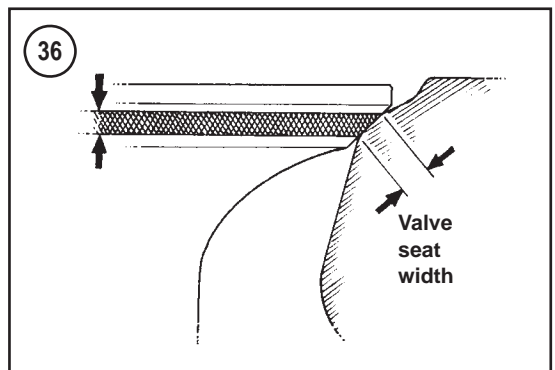
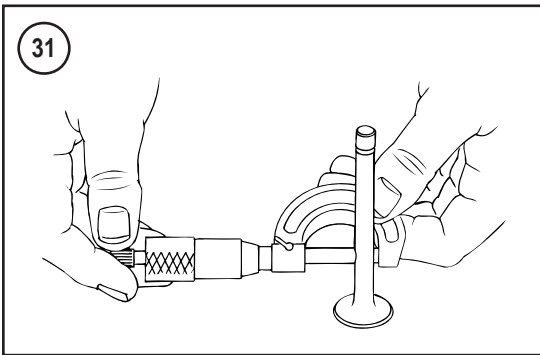
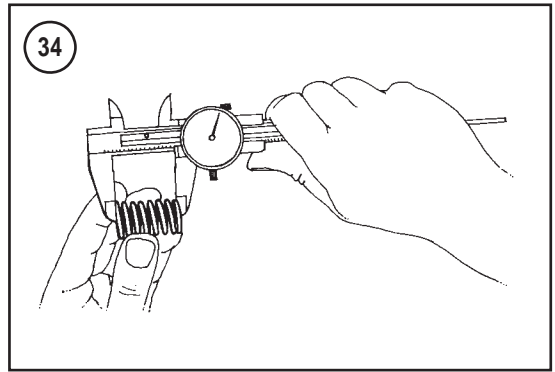
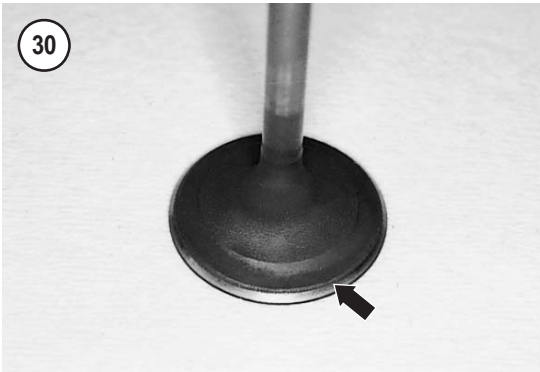
Check:

- Valve burning
- Incorrect valve clearance
- Abrasive material on valve face and seat

Valve damage

Check:

- Valve burning
- Incorrectly installed or serviced valve guides
- Incorrect valve clearance
- Incorrect valve, spring seat and retainer assembly
- Detonation caused by incorrect ignition and/or carburetor adjustments



their equivalent, are required to replace the valve guides.

1. If still installed, remove the intake manifold and its O-ring from the cylinder head.

CAUTION

Do not heat the cylinder head with a torch (propane or acetylene). Never bring a flame into contact with the cylinder head. The direct heat destroys the case hardening and may warp the head.

2. The valve guides are installed with a slight interference fit. Heat the cylinder head in a shop oven or on a hot plate. Heat the cylinder head to 100-150° C (212-300° F). Use temperature indicator sticks, available at welding supply stores, to monitor the cylinder head temperature.

3. Place the new valve guides in the freezer overnight to reduce their outside diameters.

WARNING

Wear welding gloves when performing the following procedure. The cylinder head is hot.

4. Remove the cylinder head from the oven or hot plate. Place it on wooden blocks with the combustion chamber facing up.

CAUTION

Do not remove the valve guides if the head is not hot enough. Doing so may damage the valve guide bore.

5. From the combustion side of the cylinder head, drive out the old valve guide (**Figure 37**) with a hammer and the 5-mm valve guide driver.

6. Remove and discard the valve guide and its O-ring. Never reuse a valve guide or O-ring. They are no longer true nor within tolerance.

7. After the cylinder head cools, check the guide bore for carbon or other contamination.

8. Reheat the cylinder head to 100-150° C (212-300° F).

9. Remove the cylinder head from the oven or hot plate, and place it on wooden blocks with the combustion chamber facing down.

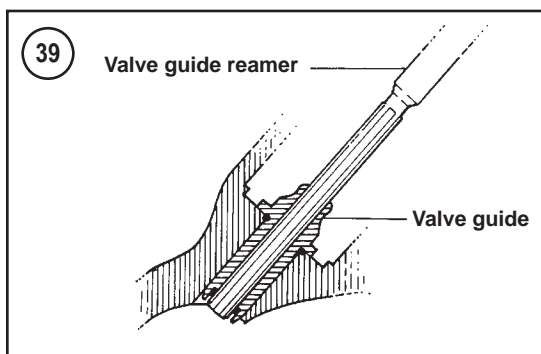
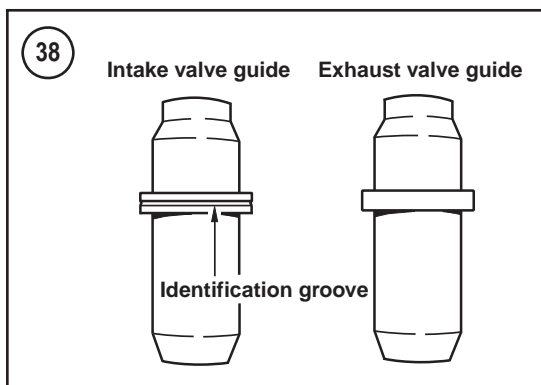
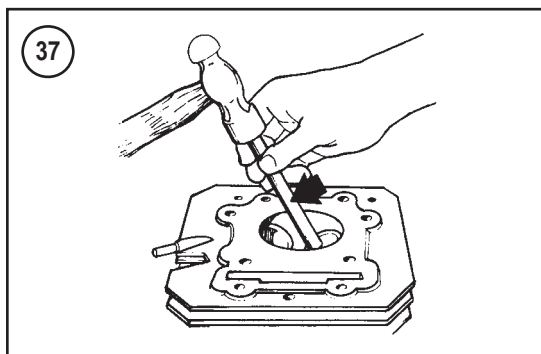
CAUTION

*The intake and exhaust valve guides are not interchangeable. The intake valve guide has an identification line on its lip that is not on the exhaust valve guide. Refer to **Figure 38**.*

10. Remove a new valve guide from the freezer, and install a new O-ring onto the valve guide.

11. Apply fresh engine oil to the new valve guide and to the valve guide bore in the cylinder head.

12. From the top side (valve side) of the cylinder head, drive the new valve guide into place with the valve guide driver. Drive the valve guide until the ring completely seats in the cylinder head.



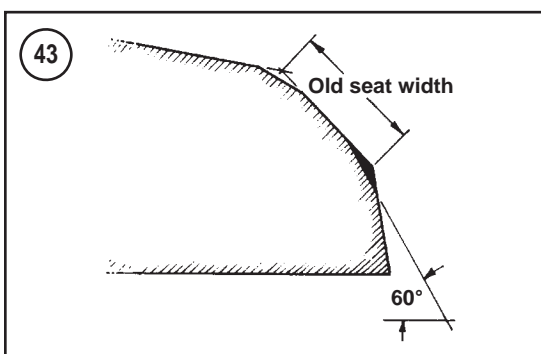
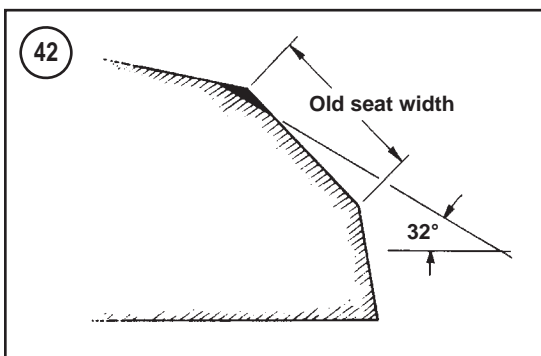
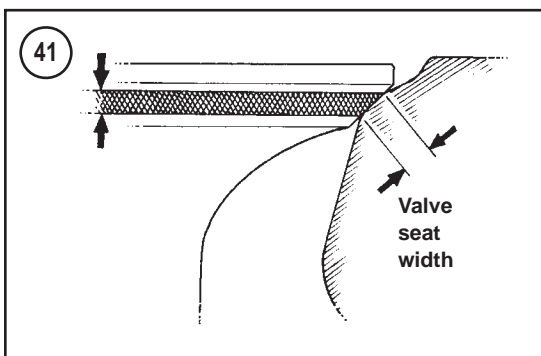
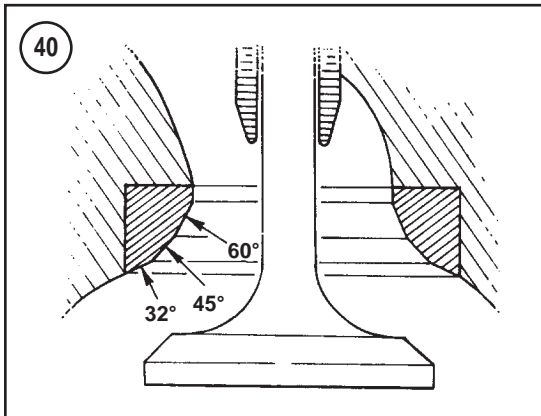
13. After installation, ream the new valve guide by performing the following:

- Use the valve guide reamer.
- Apply cutting oil to both the new valve guide and the valve guide reamer.

CAUTION

*Always rotate the reamer **clockwise**. The valve guide is damaged if the reamer is rotated counterclockwise.*

- Insert the reamer from the combustion chamber side and rotate it clockwise *through the*



valve guide (**Figure 39**). Continue to rotate the reamer and work it down through the entire length of the new valve guide. Apply additional cutting oil during this procedure.

- d. While rotating the reamer clockwise, *withdraw the reamer from the valve guide*.
- e. Measure the valve guide inside diameter with a small hole gauge. This measurement must be within the specification in **Table 2**.

14. Repeat for the other valve guides.

15. Thoroughly clean the cylinder head and valve guides with solvent to remove all metal particles. Clean the cylinder head with hot, soapy water, rinse the head completely and thoroughly dry it with compressed air.

16. Lubricate the valve guides with engine oil.

Valve Seat Reconditioning

Reconditioning the valve seats requires special valve cutting tools with the angles shown in **Figure 40**.

CAUTION

When cutting valve seats, work slowly to avoid removing too much material. An overcut seat moves the valve farther into the head, which reduces valve clearance and may make it impossible to obtain the correct clearance.

1. Install a 45° cutter onto the T-handle. Use the 45° cutter to descale and clean the valve seat with one or two turns.
2. Measure the valve seat width (**Figure 41**) with a vernier caliper, and record the measurement. Use it as a reference during the remainder of the procedure.

CAUTION

The 32° cutter removes material quickly. Work carefully and check the progress often.

3. Use the 32° cutter to lightly remove the top 1/4 of the existing valve seat (**Figure 42**).
4. Use the 60° cutter too lightly remove the lower 1/4 of the existing valve seat (**Figure 43**).
5. Measure the valve seat width (**Figure 41**) with a vernier caliper. Use the 45° cutter to cut the valve seat to the specified width in **Table 2**. Refer to **Figure 44**.

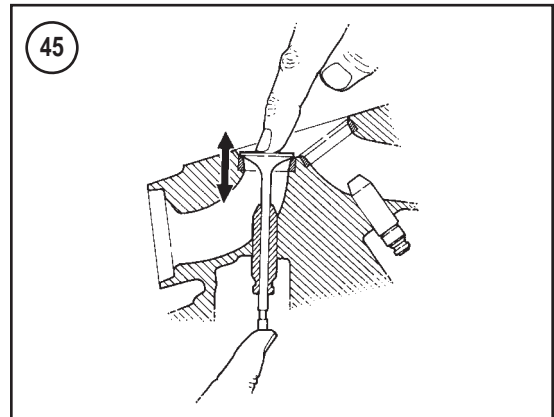
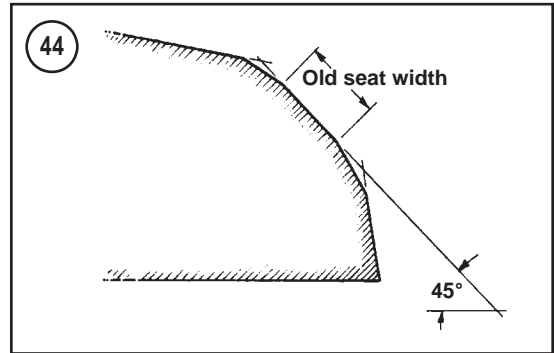
6. Once the valve seat width is within specification, check the valve seating by performing the following:

- a. Clean the valve seat with contact cleaner.
 - b. Evenly spread a thin layer of marking compound on the valve face.
 - c. Once the compound is dry, insert the valve into its guide.
 - d. Support the valve by hand (**Figure 45**), and tap the valve up and down in the cylinder head. Do not rotate the valve. This yields a false reading.
 - e. Remove the valve, and examine the impression left by the marking compound. Measure the valve seat width (**Figure 41**). The valve contact area should be approximately in the center of the valve seat area and within specification.
7. If the valve contact area is too high or too low, perform the following:
- a. If the contact area is too high on the valve or if it is too wide, use the 32° cutter to remove a portion of the top area of the valve seat, which lowers and narrows the contact area (**Figure 42**).
 - b. If the contact area is too low on the valve or if it is too wide, use the 60° cutter to remove a portion of the lower area of the valve seat, which raises and narrows the contact area (**Figure 43**).
8. Once the desired valve seat position and width is obtained, use the 45° cutter to very lightly clean off any burrs that may have been caused by previous cuts.
9. Lap the valve to the seat as described in this section.
10. Repeat Steps 1-9 for the other valve.
11. Clean the cylinder head and all valve components in solvent or detergent and hot water. Dry all parts thoroughly.
12. Once the components are completely dry, apply a light coat of engine oil to all bare metal surfaces to prevent rust.

Valve Lapping

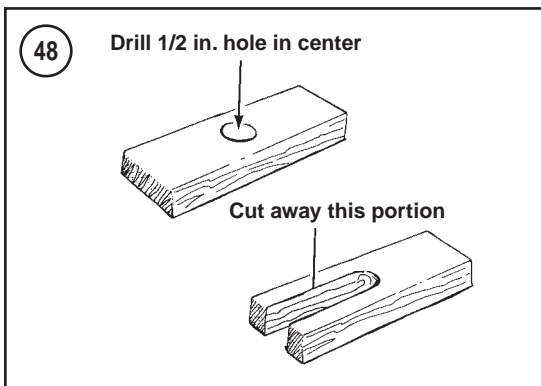
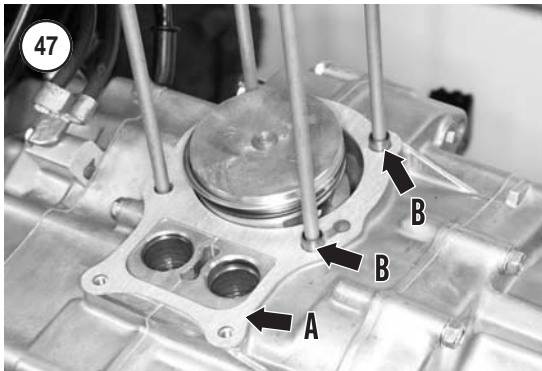
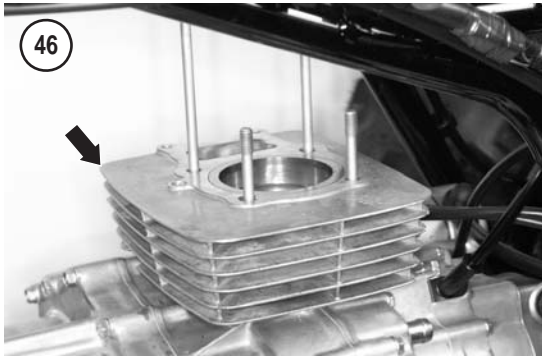
Valve lapping can restore the valve seat without machining, if the amount of wear or distortion is not too great.

Perform this procedure after determining that the valve seat width and outside diameter are within



specification. Refer to the *Component Inspection* procedure in this section.

1. Smear a light coating of fine grade valve lapping compound on the valve face.
2. Insert the valve into the head.
3. Wet the suction cup of the lapping stick and stick it onto the head of the valve. Lap the valve to the seat by spinning the lapping stick in both directions. Every 5 to 10 seconds, rotate the valve 180° in the valve seat. Continue this action until the mating surfaces on the valve and seat are smooth and equal in size.
4. Closely examine the valve seat in the cylinder head. It should be even with a smooth, polished seating ring.
5. Thoroughly clean the valves and cylinder head in solvent and then with hot soapy water to remove all lapping compound. Any compound left on the valves or the cylinder head contaminates the engine oil and causes excessive wear and damage. After drying the cylinder head, lubricate the valve guides with engine oil to prevent rust.
6. After installing the valves into the cylinder, test the valve seat seal as described in *Solvent Test*. If



fluid leaks past the seat, remove the valve assembly and repeat the lapping procedure until there are no leaks. When there are no leaks, remove both valve sets and reclean the cylinder head assembly.

CYLINDER

The alloy cylinder has a pressed-in cast iron cylinder liner. Oversize piston and ring sizes are available through Honda dealerships and aftermarket piston suppliers.

The cylinder and piston can be serviced with the engine mounted in the frame. Because of the engine's mounting position in the frame, the following photographs are shown with the engine removed for clarity.

Removal

1. Remove the pushrods and cylinder head as described in this chapter.
2. Loosen the cylinder by tapping around the perimeter with a rubber or plastic mallet.
3. Lift the cylinder (**Figure 46**) straight up and off the crankcase studs.
4. Remove the gasket (**A, Figure 47**) and two dowels (**B**).
5. If necessary, remove the piston as described in this section.
6. If necessary, remove the cam followers as described in *Camshaft* in this chapter.
7. Cover the crankcase opening to prevent objects from falling into the crankcase.

Installation

1. Check that the top and bottom cylinder surfaces are clean of all gasket residue.
2. If removed, install the cam followers as described in *Camshaft* in this chapter.
3. If removed, install the piston and rings as described in this chapter.

CAUTION

Make sure to install and secure the piston pin circlips.

4. Install a new base gasket (**A, Figure 47**) and the two dowels into the crankcase (**B**). Make sure all holes in the gasket align with their mating holes in the crankcase.

NOTE

*A piston holding fixture can be made from wood as shown in **Figure 48**.*

5. Install a piston holding fixture under the piston.
6. Lubricate the cylinder wall, piston and rings with engine oil.

CAUTION

Install the cylinder over the piston by compressing the rings with a ring

compressor. As the cylinder is installed over the piston, the compressed rings pass into the cylinder and then expand out once they are free of the ring compressor. A hose clamp works well for this. Before using a ring compressor or hose clamp, lubricate its ring contact side with engine oil. Do not overtighten the ring compressor or hose clamp. The tool should be able to slide freely as the cylinder pushes against it.

7. Compress the rings with a ring compressor or appropriate size hose clamp. Align the cylinder with the piston and *carefully* slide it down past the rings. When all the rings are installed in the cylinder, hold the cylinder and remove the ring compressor or hose clamp.

8. Remove the piston holding fixture, and slide the cylinder (**Figure 46**) all the way down until it seats on the crankcase.

CAUTION

If the piston does not move smoothly, one of the piston rings may have slipped out of its groove when the cylinder was installed. Lift the cylinder and piston up together so there is space under the piston. Install a clean rag under the piston to catch any pieces from a broken piston ring, and then remove the cylinder.

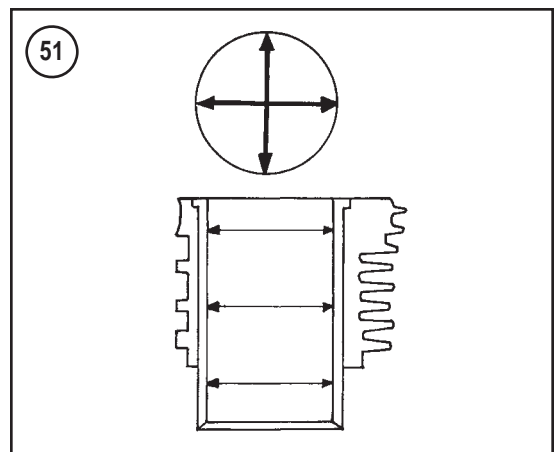
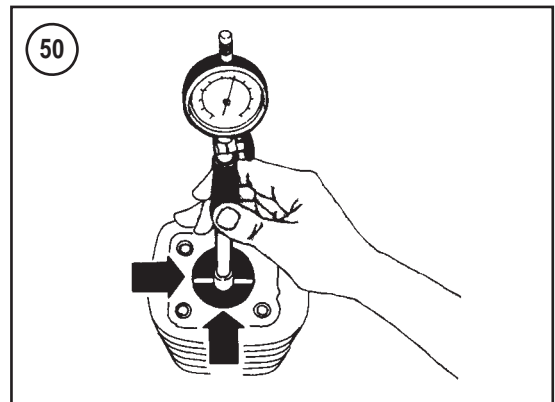
9. While holding the cylinder down with one hand, turn the engine over by rotating the alternator bolt clockwise. The piston must move up and down in the bore with no binding or roughness.

10. Install the cylinder head and pushrods as described in this chapter.

Inspection

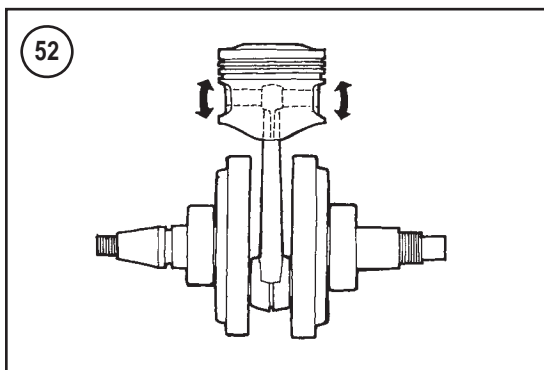
Refer to **Table 2** when inspecting the cylinder. Replace parts that are damaged or out of specification.

1. Remove all gasket residue from the top and bottom cylinder gasket surfaces.
2. Wash the cylinder in solvent, and dry it with compressed air.
3. Check the dowel pin holes for cracks or other damage.



4. Check the cylinder for warp with a feeler gauge and straightedge as shown in **Figure 49**. Check for warp at several places on the cylinder. If warp exceeds the service limit, refer service to a Honda dealership.

5. Measure the cylinder bore inside diameter with a bore gauge or inside micrometer (**Figure 50**) at the top, middle and bottom of the cylinder. At each lo-



6. If the cylinder is not worn past the service limit, check the bore for scratches or gouges. The bore still may require boring and reconditioning.

CAUTION

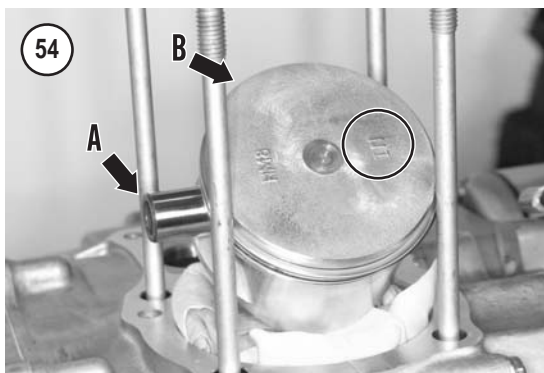
The soap and water described in Step 7 is the only solution that can wash the fine grit residue out of the cylinder crevices. Solvent and kerosene cannot do this. Grit residue left in the cylinder causes rapid and premature wear to the new rings and cylinder bore surface.



7. After servicing the cylinder, wash the bore in hot, soapy water. This is the only way to clean the cylinder wall of the fine grit material left from the bore or honing job. After washing the cylinder wall, run a clean white cloth through it. The cylinder must be free of all grit and other residue. If the rag is dirty, rewash the cylinder wall again and recheck with the white cloth. Repeat until the cloth comes out clean. When the cylinder is clean, lubricate it with engine oil to prevent the cylinder liner from rusting.

PISTON AND PISTON RINGS

The piston is made of an aluminum alloy. The piston pin is made of steel and is a precision fit in the piston. The piston pin is held in place by a circlip at each end.



cation, measure the bore in-line with the piston pin and at 90° to the pin. Refer to **Figure 51**. If the bore inside diameter, taper or out-of-round exceeds the service limit, the cylinder must be rebored to the next oversize and a new piston and ring assembly installed. Refer this service to a Honda dealership or a qualified machine shop.

NOTE

*To determine piston clearance, refer to **Piston and Piston Rings** in this chapter.*

Piston Removal

1. Remove the cylinder as described in this chapter.
2. Use rags to block the crankcase below the piston to prevent the piston pin circlips from falling into the crankcase.
3. Before removing the piston, hold the rod and rock the piston (**Figure 52**). Any rocking motion (do not confuse with the normal sliding motion) indicates wear on the piston pin, rod bore, pin bore or a combination of all three.

WARNING

Wear safety glasses when removing the circlips in Step 4.

4. Remove the circlips (**Figure 53**) from the piston pin bore grooves.
5. Push the piston pin (A, **Figure 54**) out of the piston by hand. If the pin is tight, fabricate a tool (**Figure 55**) to remove it. Do not drive the piston pin out.

The driving force could damage the piston pin, connecting rod or piston.

6. Lift the piston (B, **Figure 54**) off the connecting rod.
7. Inspect the piston as described in this section.

Piston Installation

1. Install the piston rings onto the piston as described in this section.
2. Install a *new* piston pin circlip into one piston pin bore. The circlip ends must not align with the cutout in the piston (**Figure 56**).
3. Cover the crankcase opening with clean rags.
4. Coat the connecting rod bore, piston pin and piston with engine oil.
5. Slide the piston pin into the piston until its end is flush with the piston pin boss as shown in **Figure 57**.
6. Place the piston over the connecting rod so the IN mark (**Figure 54**) on the piston crown faces the intake side (rear) of the engine.
7. Align the piston pin with the hole in the connecting rod. Push the piston pin (A, **Figure 54**) through the connecting rod until the pin clears the circlip groove or until it bottoms against the circlip on the opposite side of the piston.

WARNING

Wear safety glasses or goggles when installing the piston pin circlips in Step 8.

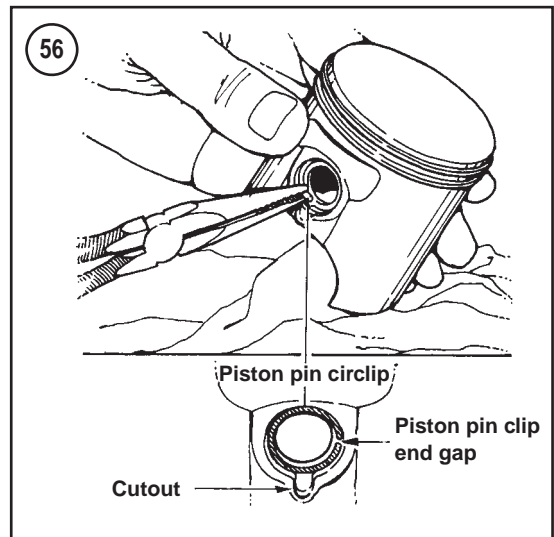
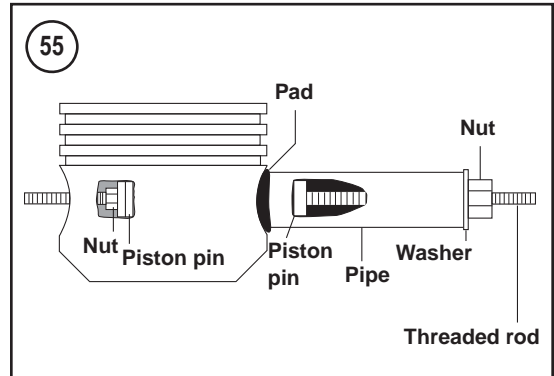
8. Install a *new* piston pin circlip (**Figure 53**) into the remaining piston pin bore. Make sure the circlips seat in the grooves completely. Turn the circlip so its end gap does not align with the cutout in the piston (**Figure 56**).

Piston Inspection

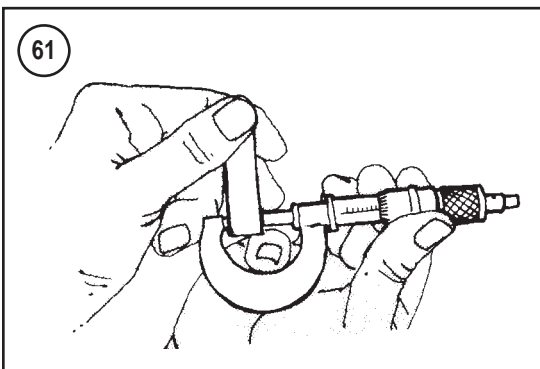
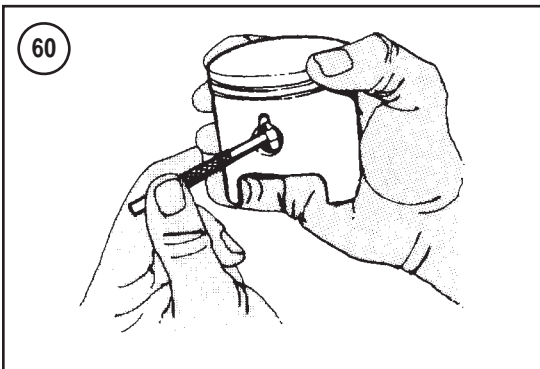
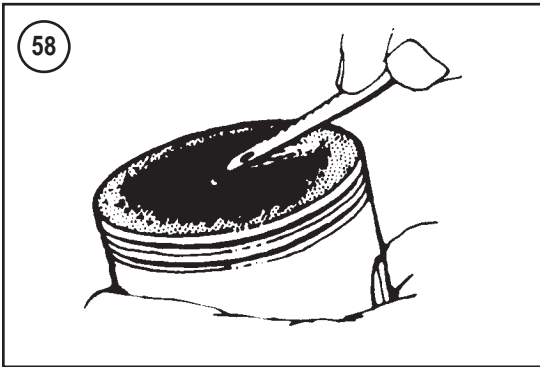
1. Remove the piston rings as described in this section.
2. Clean the carbon from the piston crown (**Figure 58**) with a soft scraper. Large carbon accumulations reduce piston cooling and cause detonation and piston damage.

CAUTION

Do not wire brush the piston skirt.



3. After cleaning the piston, examine the crown. The crown must show no signs of wear or damage. If the crown appears pecked or spongy-looking, also check the spark plug, valves and combustion chamber for aluminum deposits. If these deposits are found, the engine is overheating.



4. Examine each ring groove for burrs, dented edges or other damage. Pay particular attention to the top compression ring groove because it usually wears more than the others. Because the oil rings are bathed in oil, the rings and grooves wear less than compression rings and their grooves. If there is evidence of oil ring groove wear or if the oil ring is tight and difficult to remove, the piston skirt may have collapsed due to excessive heat. Replace the piston.

5. Check the piston oil control holes for carbon or oil sludge buildup. Clean the holes with wire.

6. Check the piston skirt (**Figure 59**) for cracks or other damage. If the piston shows signs of partial seizure (bits of aluminum buildup on the piston skirt), replace the piston and bore the cylinder (if necessary) to reduce the possibility of engine noise and further piston seizure.

NOTE

If the piston skirt is worn or scuffed unevenly from side to side, the connecting rod may be bent or twisted.

7. Check the piston circlip grooves for wear, cracks or other damage. If a circlip groove is worn, replace the piston.

8. Measure piston-to-cylinder clearance as described in this section.

9. If damage or wear indicates piston replacement is necessary, select a new piston as described in *Piston Clearance* in this section. If the piston, rings and cylinder are not damaged and are dimensionally correct, they can be reused.

Piston Pin Inspection

Refer to **Table 2** when inspecting the piston pin components in this section. Replace parts that are out of specification or show damage.

1. Clean and dry the piston pin.
2. Inspect the piston pin for chrome flaking, cracks or signs of heat damage.
3. Measure the piston pin bore inside diameter (**Figure 60**).
4. Measure the piston pin outside diameter (**Figure 61**).
5. Subtract the piston pin outside diameter (Step 4) from the piston pin bore inside diameter (Step 3) to determine the piston-to-piston pin clearance. Replace the piston and/or piston pin if the clearance is excessive.



Connecting Rod Small End Inspection

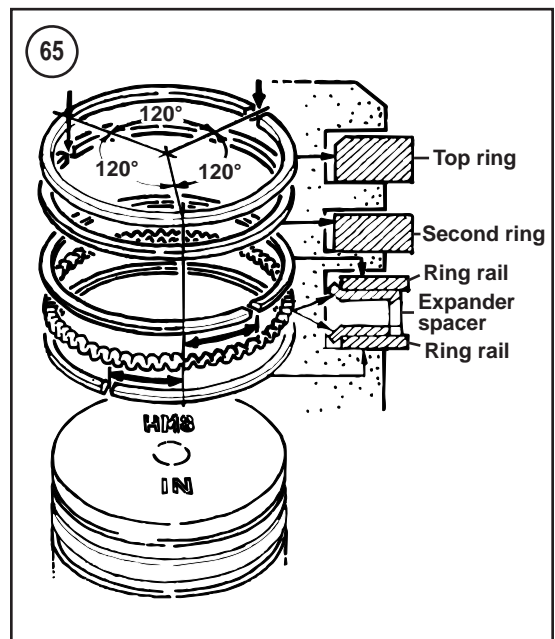
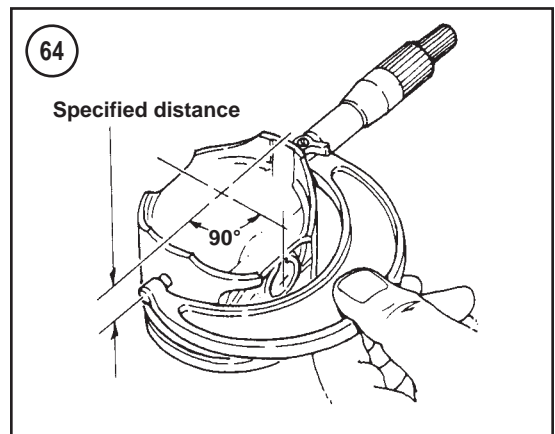
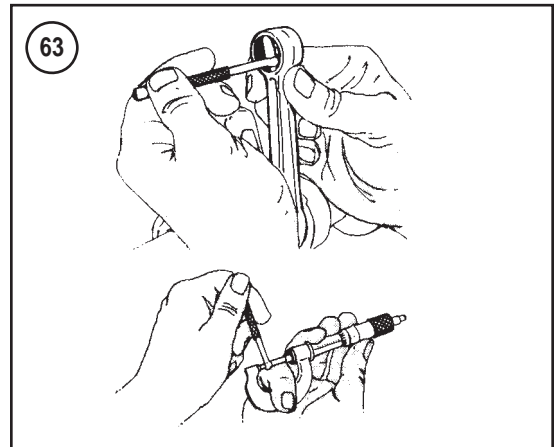
1. Inspect the connecting rod small end (**Figure 62**) for cracks or signs of heat damage.
2. Measure the small end inside diameter with a snap gauge (**Figure 63**). Measure the snap gauge with a micrometer. If the small end inside diameter exceeds the service limit in **Table 2**, replace the crankshaft assembly. The connecting rod cannot be replaced separately.

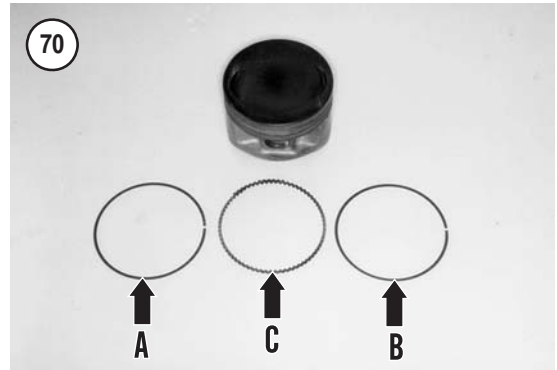
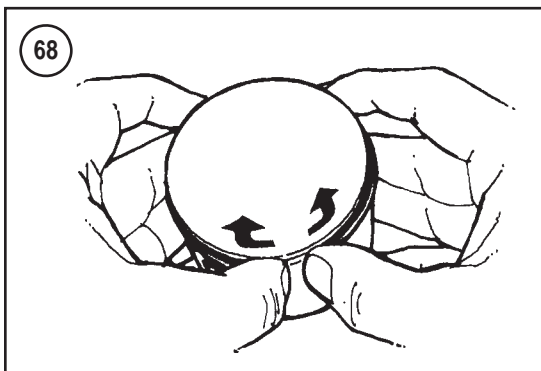
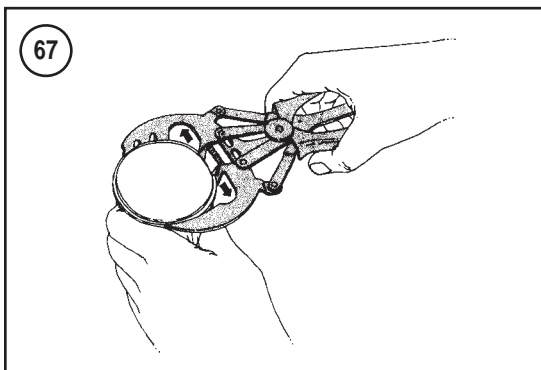
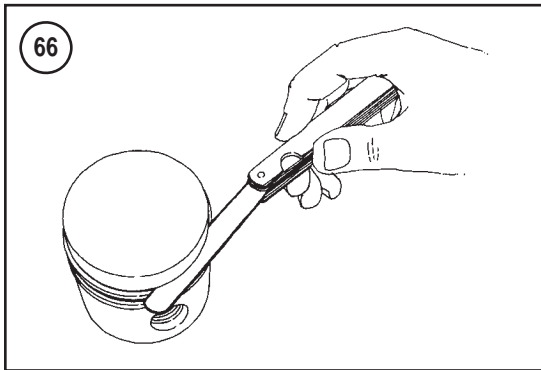
Piston Clearance

1. Make sure the piston and cylinder walls are clean and dry.
2. Measure the cylinder bore inside diameter as described in *Cylinder Inspection*. Record the largest bore inside diameter measurement.
3. Measure the piston diameter with a micrometer at a right angle to the piston pin bore. Measure piston diameter at the specified distance (**Table 2**) from the bottom edge of the piston skirt as shown in **Figure 64**. Record the piston diameter measurement.
4. Subtract the piston diameter from the largest bore diameter. This difference is piston-to-cylinder clearance. If clearance exceeds the service limit in **Table 2**, the cylinder must be bored to the next over-size and a new piston/ring assembly installed.

Piston Ring Inspection and Removal

The piston uses a three-ring assembly (**Figure 65**). The top and second rings are compression rings. The lower ring is an oil control ring assembly, which consists of two ring rails and an expander spacer.





1. Measure the piston-to-groove clearance of each compression ring with a flat feeler gauge (**Figure 66**). If the clearance is greater than specified, replace the rings. If the clearance is still excessive with the new rings, replace the piston.

WARNING

The piston rings are very sharp. Be careful when handling them.

2. Remove the compression rings with a ring expander tool (**Figure 67**) or spread the ring ends by hand (**Figure 68**). Lift the rings out of their grooves and up, over the piston.

3. Remove the oil ring assembly (**Figure 69**) by first removing the upper (A, **Figure 70**) and then the lower (B) ring rails. Remove the expander spacer (C, **Figure 70**).

CAUTION

When cleaning the piston ring grooves in Step 4, use the same type of ring that operates in the groove. Using a dissimilar ring damages the groove.

4. Using a broken piston ring, remove carbon and oil residue from the piston ring grooves (**Figure 71**).

CAUTION

Do not remove aluminum material from the ring grooves because this increases ring side clearance.

5. Inspect the ring grooves for burrs, nicks or broken or cracked lands. Replace the piston if necessary.

NOTE

When measuring the oil control ring end gap, measure the upper and lower

ring rail end gaps only. Do not measure the expander spacer (C, **Figure 70**).

6. Check the end gap of each ring compression ring and both oil ring side rails. Perform the following:
 - a. Insert each ring into the bottom of the cylinder bore and square it with the cylinder wall by tapping it with the piston (**Figure 72**).
 - b. Measure the end gap with a feeler gauge. Replace the rings if the end gap exceeds the service limit in **Table 2**.
 - c. If the gap on the new ring is smaller than specified, hold a fine-cut file in a vise. File the ends of the ring to enlarge the gap (**Figure 73**).
7. Roll each ring around its piston groove (**Figure 74**) to check for binding. Repair minor binding with a fine-cut file.

Piston Ring Installation

1. Hone or deglaze the cylinder before installing new piston rings. This machining process helps the new rings seat in the cylinder. If necessary, refer this job to a Honda dealership or machine shop. After honing, measure the end gap of each ring.
2. Thoroughly clean the piston and rings. Dry them with compressed air.

NOTE

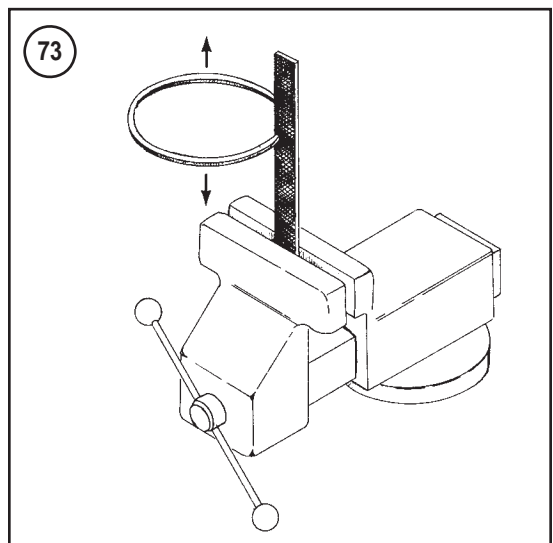
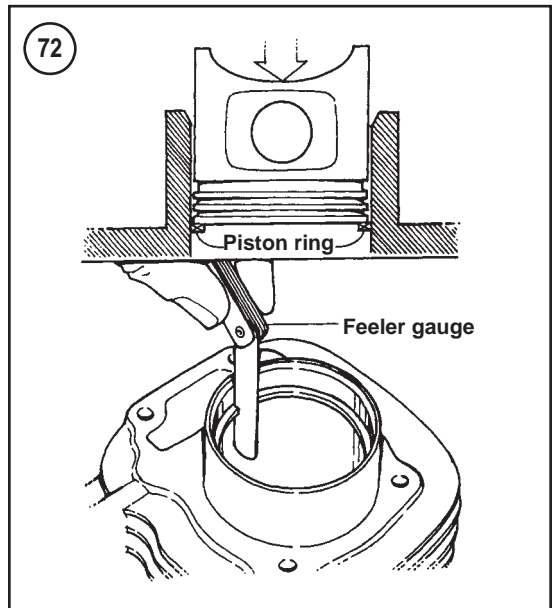
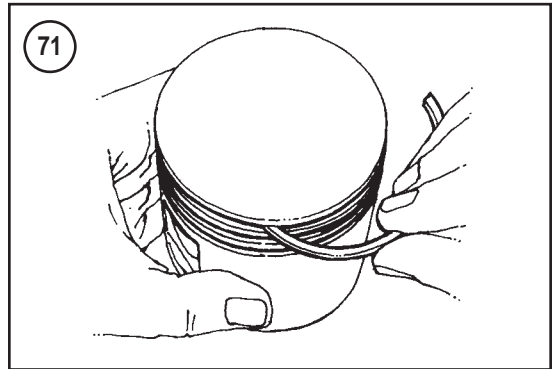
*The top and second compression rings are different. Refer to **Figure 65** to identify the rings.*

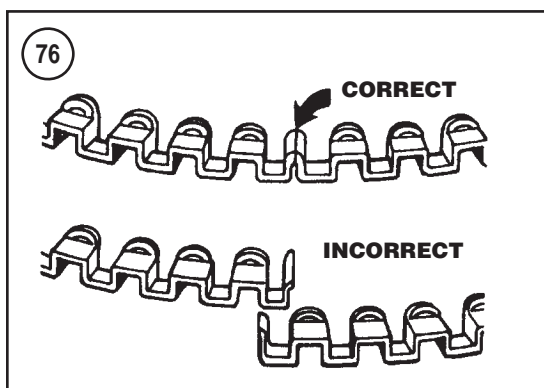
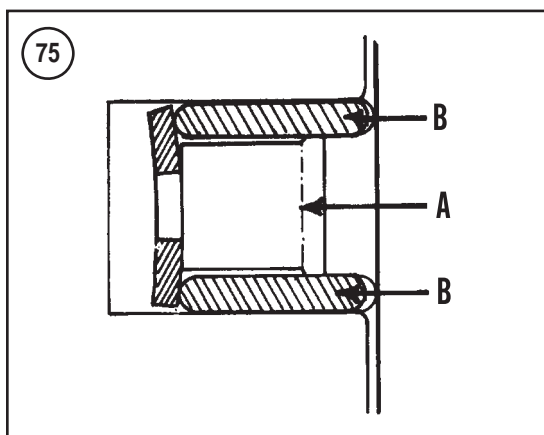
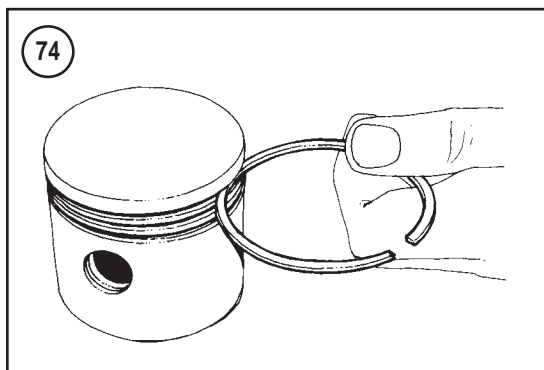
3. Install the piston rings as follows:

CAUTION

Install the piston rings—first the bottom, then the middle and then the top ring—by carefully spreading the ends by hand and slipping the rings over the top of the piston. Remember that the piston rings must be installed with the manufacturer's marks facing up. Incorrectly installed piston rings can wear rapidly and/or allow oil to escape past them.

- a. Install the oil control ring assembly into the bottom ring groove. Install the oil ring expander spacer first (A, **Figure 75**), and then install each ring rail (B). Make sure the ends





of the expander spacer butt together (**Figure 76**). They should not overlap. If reassembling used parts, install the ring rails as they were removed.

NOTE

When installing aftermarket piston rings, follow the manufacturer's directions.

- b. Install the 2nd, or middle, compression ring with the manufacturer's reference mark facing up. This ring has square edges (**Figure 65**).
- c. Install the top compression ring with the manufacturer's reference mark facing up.
4. Make sure the rings are seated completely in their grooves all the way around the piston. Also position the rings so their end gaps are distributed around the piston as shown in **Figure 65**. The ring gaps must not align with each other. This prevents compression pressures from escaping past them.

CAMSHAFT

The camshaft and cam chain tensioner assembly can be removed with the engine mounted in the frame. Because of the engine's position in the frame, the following photographs show the engine removed for clarity.

Refer to **Figure 77** when servicing the camshaft and its components. During inspection, compare measurements to the specifications in **Table 2**. Replace any components that are damaged, worn to the service limit or out of specification. During assembly, tighten fasteners to the torque specifications.

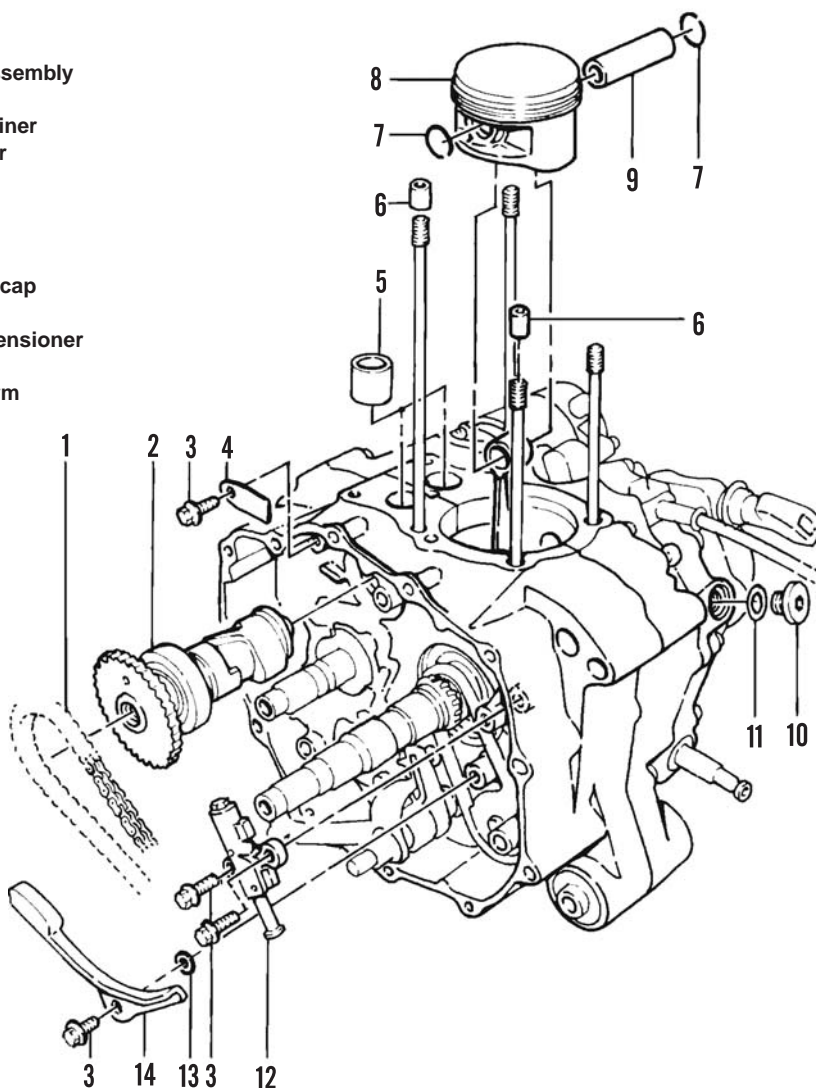
Removal

1. Remove the cylinder head and cylinder as described in this chapter.
2. Remove the centrifugal clutch and the change clutch as described in Chapter Six.
3. Remove the cam followers (**Figure 78**) from the crankcase. Mark each cam follower as it is removed so it can be reinstalled in its original location.
4. Remove the mounting bolts (A, **Figure 79**) and cam chain tensioner (B).
5. Remove the pivot bolt, washer (A, **Figure 80**), and tensioner arm (B).
6. Remove the camshaft bearing retainer bolt (**Figure 81**) and retainer.
7. Align the timing mark on the camshaft sprocket with the index mark on the crankcase (**Figure 82**).
8. Slightly pull the camshaft from the crankcase. Disengage the cam chain from the camshaft sprocket and remove the camshaft.
9. Remove the cam chain from the crankshaft timing sprocket.

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CAMSHAFT ASSEMBLY

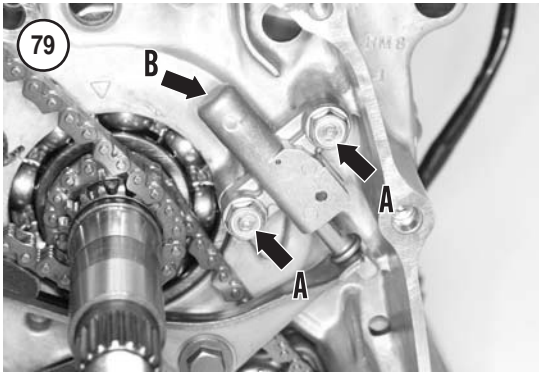
1. Cam chain
2. Camshaft assembly
3. Bolt
4. Bearing retainer
5. Cam follower
6. Dowel
7. Circlip
8. Piston
9. Piston pin
10. Timing hole cap
11. O-ring
12. Cam chain tensioner
13. Washer
14. Tensioner arm

**Installation**

1. Check that the engine is still set to top dead center. If necessary, turn the flywheel bolt to rotate the crankshaft so the T-mark on the flywheel aligns with the index mark (**Figure 83**).
2. Install the cam chain onto the crankshaft timing sprocket.
3. Apply molybdenum-disulfide oil to the cam lobes and journals on the camshaft.



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4

**CAUTION**

Do not rotate the crankshaft during camshaft and cam chain installation.

4. Position the camshaft so the cam lobes point down. Fit the camshaft through the cam chain, and slide the camshaft into the crankcase. Align the timing mark on the camshaft sprocket (**Figure 82**) with the index mark on the crankcase.

5. Install the cam chain onto the camshaft sprocket, and press the camshaft into place in the crankcase. Make sure the timing mark on the camshaft sprocket still aligns with the index mark on the crankcase.

6. Place the bearing retainer onto the crankcase boss, and secure the retainer with the mounting bolt (**Figure 81**).

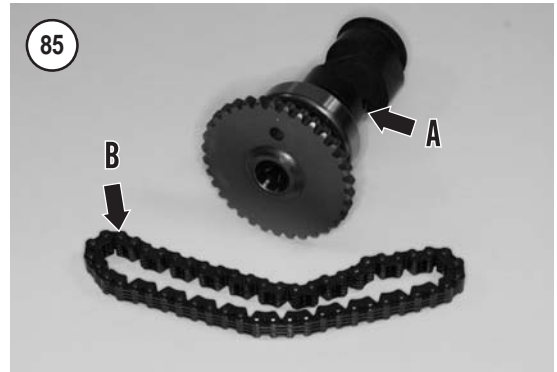
7. Install the cam chain tensioner arm (B, **Figure 80**). Apply ThreeBond 1333B, or equivalent, to the threads of the tensioner arm pivot bolt. Install the bolt along with its washer. Tighten the cam-chain-tensioner-arm pivot bolt (A, **Figure 80**) to 12 N•m (106 in.-lb.).

8. Check the operation of the tensioner arm by rotating the arm. If the tensioner arm binds, the bolt was installed incorrectly. Remove the tensioner arm and reinstall it.

CAUTION

*Check that the engine is still set to top dead center (**Figure 83**) and that the camshaft sprocket still aligns with the index mark on the crankcase (**Figure 82**).*

9. Press the tensioner release with a screwdriver (**Figure 84**). Push the pushrod into the tensioner body and hold it in place with your finger.

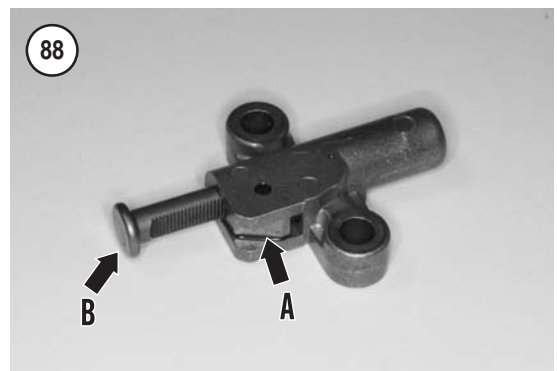
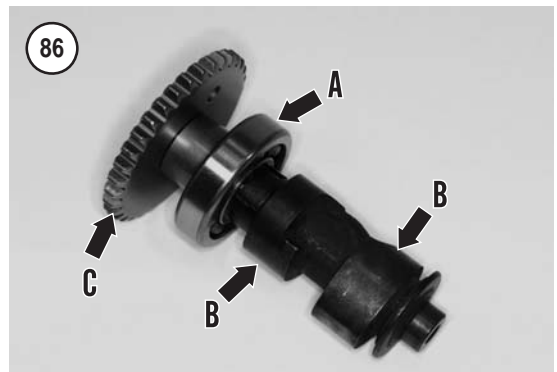


10. Install the cam chain tensioner (B, **Figure 79**), and secure it in place with the mounting bolts (A).
11. Apply engine oil to the inner and outer surfaces of the cam followers, and install each cam follower (**Figure 78**) into its original location in the crankcase.
12. Install the change clutch and the centrifugal clutch as described in Chapter Six.
13. Install the cylinder and cylinder head as described in this chapter.

Camshaft and Cam Chain Inspection

Refer to **Table 2** when inspecting camshaft components. Replace parts that are out of specification or damaged.

1. Clean and dry the camshaft assembly (A, **Figure 85**). Lubricate the bearing with engine oil.
2. Check that the camshaft bearing (A, **Figure 86**) fits tightly on the camshaft. If the bearing is loose, replace the camshaft assembly.
3. Turn the camshaft bearing by hand. The bearing must turn smoothly. If the bearing is damaged, replace the camshaft assembly.
4. Check the cam lobes (B, **Figure 86**) for scoring or other damage.
5. Measure each cam lobe height with a micrometer (**Figure 87**). Replace the camshaft if either lobe is out of specification.
6. Inspect the camshaft sprocket (C, **Figure 86**) for broken or chipped teeth. Also check the teeth for cracking or rounding. If the camshaft sprocket is damaged, replace the camshaft. Also inspect the timing sprocket mounted on the crankshaft as described in Chapter Five.
7. Inspect the cam chain (B, **Figure 85**) for excessive wear, loose or damaged pins, cracks or other damage. Replace if damaged.





Cam Chain Tensioner Inspection

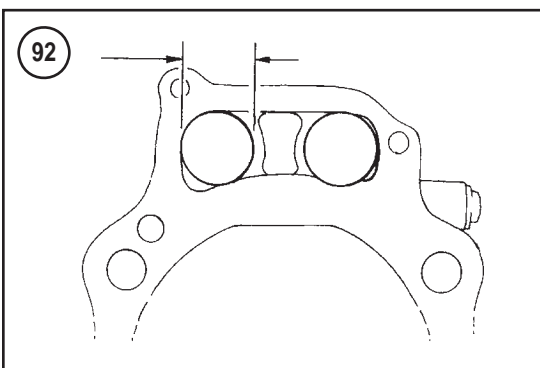
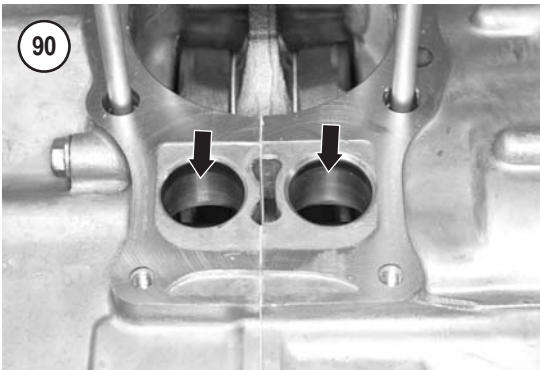
1. Press the stopper (A, **Figure 88**) into the tensioner body with a screwdriver (**Figure 84**), and check the movement of the pushrod (B, **Figure 88**). If it does not slide smoothly in and out of the housing, replace the tensioner body.
2. Inspect the sliding surface of the cam chain tensioner arm (**Figure 89**). Replace the tensioner arm if necessary.

Cam Follower Inspection

Refer to **Table 2** when inspecting the cam followers. Replace parts that are out of specification or show damage.

CAUTION

Each cam follower must be installed in its original location. Do not mix the cam followers during inspection. If necessary, reapply the identification marks made during removal.



1. Clean and dry the cam followers.
2. Inspect the cam followers for scoring, cracks or other damage.
3. Inspect the cam follower bores (**Figure 90**) in the crankcase for scoring, excessive wear or other damage.
4. Measure the cam follower outside diameter (**Figure 91**). Record the dimension. Replace the cam follower if out of specification.
5. Measure the cam follower bore inside diameter (**Figure 92**). Record the dimension. Replace the crankcase half if the bore is out of specification.
6. If the cam follower outside diameters and cam follower bore inside diameters are within specifications, calculate the cam follower-to-bore clearance as follows:
 - a. Subtract the cam follower outside diameter (Step 4) from the cam follower bore inside diameter (Step 5). The result is cam follower-to-bore clearance.
 - b. Repeat for both cam followers.
 - c. If the clearance exceeds the service limit, replace the cam follower and then remeasure. If the clearance is still out of specification, replace the crankcase half.

Table 1 GENERAL ENGINE SPECIFICATIONS

	Specification
Type and number of cylinders	4-stroke, OHV, air-cooled single
Bore x stroke	68.4 x 62.2 mm (2.70 x 2.45 in.)
Displacement	229 cc (14.0 cu. in.)
Compression ratio	9.0:1
Valve timing	
Intake	
Open	8° BTDC
Closed	38° ABDC
Exhaust	
Open	34° BBDC
Close	4° ATDC

Table 2 ENGINE TOP END SPECIFICATIONS

	Specification mm (in.)	Service limit mm (in.)
Camshaft		
Cam lobe height		
Intake	35.764-35.924 (1.408-1.414)	35.6 (1.40)
Exhaust	35.292-35.452 (1.389-1.396)	35.1 (1.38)
Cam follower outside diameter	22.467-22.482 (0.8845-0.8851)	22.46 (0.884)
(intake/exhaust)		
Cam follower bore inside diameter	22.510-22.526 (0.8862-0.8868)	22.54 (0.887)
(intake/exhaust)		
Cam follower-to-bore clearance	0.028-0.059 (0.0011-0.0023)	0.07 (0.003)
Rocker arm inside diameter	12.000-12.018 (0.4724-0.4731)	12.05 (0.474)
Rocker arm shaft outside diameter	11.964-11.984 (0.4710-0.4718)	11.92 (0.469)
Rocker arm-to-shaft clearance	0.016-0.054 (0.0006-0.0021)	0.08 (0.003)
Cylinder head warp	—	0.10 (0.004)
Cylinder compression	1275 kPa (185 psi) @ 800 rpm	—
Valves and valve springs		
Valve clearance (intake/exhaust)	0.13 (0.005)	—
Valve stem outside diameter		
Intake	5.475-5.490 (0.2156-0.2161)	5.45 (0.215)
Exhaust	5.455-5.470 (0.2148-0.2154)	5.43 (0.214)
Valve guide inside diameter	5.500-5.512 (0.2165-0.2170)	5.525 (0.2175)
(intake/exhaust)		
Stem-to-guide clearance		
Intake	0.010-0.037 (0.0004-0.0015)	0.12 (0.005)
Exhaust	0.030-0.057 (0.0012-0.0022)	0.14 (0.006)
Valve seat width (intake/exhaust)	1.2 (0.05)	1.5 (0.06)
Valve spring free length		
Inner (intake/exhaust)	42.4 (1.67)	41.2 (1.62)
Outer (intake/exhaust)	44.2 (1.74)	43.0 (1.69)
Valve seat surface angle	45°	
Valve seat cutting angle	32, 45, 60°	
Cylinder		
Bore inside diameter	68.500-68.510 (2.6968-2.6972)	68.6 (2.70)
Out of round	—	0.10 (0.004)
Taper	—	0.10 (0.004)
Warp	—	0.10 (0.004)
Oversize pistons and rings	+ 0.25, 0.50, 0.75 or 1.00	
Piston-to-cylinder clearance	0.018-0.048 (0.0007-0.0019)	0.10 (0.004)
(continued)		

Table 2 ENGINE TOP END SPECIFICATIONS (continued)

	Specification mm (in.)	Service limit mm (in.)
Pistons		
Outside diameter	68.462-68.482 (2.6953-2.6961)	68.4 (2.69)
Outside diameter measuring point	6-14 (0.2-0.6) from bottom of skirt	
Piston pin bore inside diameter	15.002-15.008 (0.5906-0.5909)	15.04 (0.592)
Piston pin outside diameter	14.994-15.000 (0.5903-0.5906)	14.96 (0.589)
Piston-to-piston pin clearance	0.002-0.014 (0.0001-0.0006)	0.020 (0.0008)
Piston rings		
Ring-to-groove clearance		
Top	0.015-0.045 (0.0006-0.0018)	0.09 (0.0004)
Second	0.015-0.045 (0.0006-0.0018)	0.09 (0.0004)
Ring end gap		
Top	0.20-0.35 (0.008-0.014)	0.5 (0.02)
Second	0.40-0.55 (0.016-0.022)	0.7 (0.03)
Oil ring side rail	0.20-0.70 (0.008-0.028)	—
Connecting rod		
Small end inside diameter	15.010-15.028 (0.5909-0.5917)	15.06 (0.593)
Rod-to-piston pin clearance	0.010-0.034 (0.0004-0.0013)	0.10 (0.004)

Table 3 ENGINE TOP END TORQUE SPECIFICATIONS

Item	N•m	in.-lb.	ft.-lb.
Cam chain tensioner arm pivot bolt*	12	106	—
Cylinder head flange nuts	30	—	22
Cylinder head cover bolts	12	106	—
Cylinder head studs	6	53	—
Engine mounting bolts and nuts			
Lower engine mount	54	—	40
Cylinder head cover mount	32	—	24
Engine oil drain plug	25	—	18
Exhaust pipe protector bolt	22	—	16
Muffler clamp bolt	23	—	17
Rocker arm shaft bolt	10	89	—
Valve adjuster caps	20	—	14
Valve adjuster locknut	17	—	12
*Apply threadlocking compound.			

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